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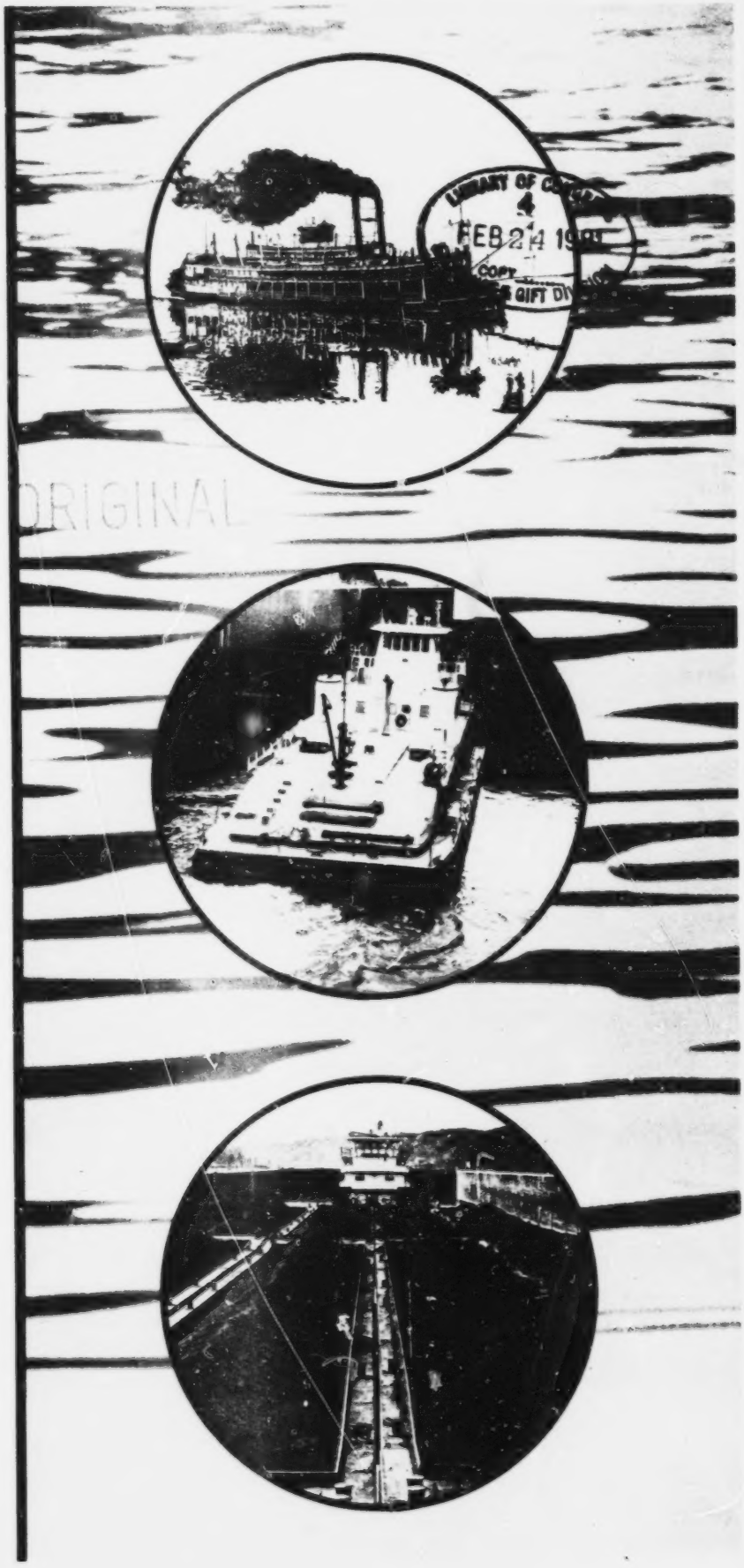
Projections Of Demand For Waterborne Transportation

Ohio River Basin
1980 - 2040

Volume 16

Manufactured Products, Nec.



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REPORT DOCUMENTATION PAGE

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Inland waterways	Traffic surveys	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System. Each of the studies considers existing waterborne commerce and develops a consistent set of projects of future traffic demands for all of the navigable waterways of the Basin. Each report contains information on past and present waterborne commerce in the Basin and projections by commodity groups and origin-destination areas from 1976 to at least 1990.

(Continued from #20)
The three study projections, in conjunction with other analytical tools and system information, will be used to evaluate specific waterway improvements to meet short and long-term navigation needs. The output from these studies will serve as input to Corps' Inland Navigation Simulation Models to help analyze the performance and opportunities for improvement of the Ohio River Basin Navigation System. These data will be used in current studies relating to improvement of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, the Cumberland River and the Tennessee River, as well as other improvements.

This document is volume 16 of the 17 volume report shown below.

The study included a Commodity Resource Inventory, a Modal Split Analysis and a Market Demand Analysis. The work included investigation and analyses of the production, transportation and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of and within the Ohio River Basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A study summary aggregates the commodity group totals for each of the several projections periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin. The study results are presented in the following 17 documents:

Volume	Subject Title
1	Study summary
2	Methodology
3	Group I: Coal and coke
4	Group II: Petroleum fuels
5	Group III: Crude Petrol.
6	Group IV: Aggregates
7	Group V: Grains
8	Group VI: Chemicals and chemical fertilizers
9	Group VII: Ores and Minerals
10	Group VIII: Iron ore, steel and iron
11	Group IX: Feed and food products, nec.
12	Group X: Wood and paper products
13	Group XI: Petroleum products, nec.
14	Group XII: Rubber, plastics, nonmetallic, mineral, products, nec.
15	Group XIII: Nonferrous, metals and alloys, nec.
16	Group XIV: Manufactured products, nec.
17	Group XV: Other, nec.

Additionally, an Executive Summary is available as a separate document.

Volume 16 of 17

GROUP XIV : MANUFACTURED PRODUCTS, NEC.

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION OHIO RIVER BASIN 1980, 1990, 2000, 2020, 2040

Prepared for

U.S. ARMY CORPS OF ENGINEERS
OHIO RIVER DIVISION, HUNTINGTON DISTRICT

Contract No. DACW69-78-C-0136

by

Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

DECEMBER 1980

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"...one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System."

CONTENTS: v.1. Study summary.--v.2. Methodology.--v.3. Commodity groups .

1. Shipping--Ohio River Basin. 2. Inland water transportation--Ohio River Basin--Statistics. 3. Ohio River Basin. I. United States. Army. Corps of Engineers. Ohio River Division. II. United States. Army. Corps of Engineers. Huntington District. III. Title.

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PREFACE

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River basin navigation system. Each of the studies considers existing waterborne commerce and develops a consistent set of projections of future traffic demands for all of the navigable waterways of the basin. Each report contains information on past and present waterborne commerce in the basin with projections by commodity group and origin-destination areas from 1976 to either 1990 or 2040.

The three projections, in conjunction with other analytical tools and waterway system information, will be used to evaluate specific waterway improvements required to meet short and long-term navigation needs. The output from these studies will serve as input to Corps inland navigation simulation models to help analyze the performance and requirements for improvements of the Ohio River basin navigation system. These data will be used in current studies relating to improvements of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, and the Tennessee River, as well as for other improvements.

The reports on the three studies are referred to as the "CONSAD," the "BATTELLE," and the "NATHAN" reports. The latter and final report was completed in November 1980. It was prepared for the Corps of Engineers by Robert R. Nathan Associates, Inc., Consulting Economists, Washington D.C. This study encompasses the period 1976-2040, and is by far the most detailed of the three.

The "CONSAD" report, completed in January 1979, was prepared for the Corps by the CONSAD Research Corporation of Pittsburgh, Pennsylvania. The study and the 1976-1990 projected traffic demands discussed in that report were developed by correlating the historic waterborne commodity flows on the Ohio River navigation system, with various indicators of regional and national demands for the commodities. The demand variables which appeared to best describe the historic traffic pattern for each of the commodity groups was selected for projection purposes. The projected values for the demand variables are based upon the 1972 OBERS Series E Projections of National and Regional Economic Activity. The OBERS projections serve as national standards and were developed by the Bureau of Economic Analysis of the U.S. Department of Commerce, in conjunction with the Economic Research Service of the Department of Agriculture.

The "BATTELLE" report was completed in June 1979, and was prepared for the Corps by the Battelle Columbus Laboratories, Columbus, Ohio. The study and the 1976-1990 traffic projections discussed in that report were developed by surveying all waterway users in the Ohio River Basin through a combined mail survey and personal interview approach. The purpose of the survey was to obtain an estimate from each individual shipper of his future commodity

movements, by specific origins and destinations, as well as other associated traffic information. All identifiable waterway users were contacted and requested to provide the survey information. In addition, personal interviews were held with the major shippers. The responses were then aggregated to yield projected traffic demands for the Ohio River navigation system.

The "NATHAN" report presents the findings of a commodity resource inventory, a modal split analysis and a market demand analysis. The work included investigation and analyses of the production, transportation, and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of, and within the Ohio River basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A Study Summary and an Executive Summary present appropriately abbreviated discussion and findings resulting from these analyses. The Study Summary aggregates the commodity group totals for each of the several projection periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin.

The "NATHAN" report, "Projections of Demand for Waterborne Transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040" consists of the following volumes:

Subject Title	Number of Pages	Volume Number
Study Summary	220	1
Methodology	118	2
Group I: Coal and Coke	134	3
Group II: Petroleum Fuels	66	4
Group III: Crude Petroleum	42	5
Group IV: Aggregates	64	6
Group V: Grains	131	7
Group VI: Chemicals and Chemical Fertilizers	90	8
Group VII: Ores and Minerals	61	9
Group VIII: Iron Ore, Steel and Iron	104	10
Group IX: Feed and Food Products, Nec.	44	11
Group X: Wood and Paper Products	61	12
Group XI: Petroleum Products, Nec.	38	13
Group XII: Rubber, Plastic, Nonmetallic Mineral Products, Nec.	41	14
Group XIII: Nonferrous Metals and Alloys, Nec.	57	15
Group XIV: Manufactured Products Nec.	35	16
Group XV: Others, Nec.	48	17

Additionally, an Executive Summary is available as a separate document.

RRNA

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION
OHIO RIVER BASIN
1980, 1990, 2000, 2020, 2040

Group XIV: Manufactured Products, Nec.

Prepared for
U.S. Army Corps of Engineers
Huntington District
Contract No. DACW69-78-C-0136

by
Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

November 1980

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I. INTRODUCTION

Group XIV, manufactured products, nec., consists of fabricated metal products, machinery, transportation equipment, and other manufactured products. Of the 15 commodity groups analyzed for this study, Group XIV has ranked 14th, in terms of total traffic, during most of the period 1969-76. In 1976, movements of manufactured products, nec., contributed 0.2 percent of total waterborne traffic in the Ohio River System (ORS).

The areas within the Ohio River Basin (ORB) for which projections of Group XIV consumption, production and movements have been made are designated as Primary Study Areas (PSAs). The PSAs for Group XIV are those U.S. Department of Commerce Bureau of Economic Analysis Areas (BEAs) and area segments (aggregations of counties within a BEA) which are origins or destinations of Group XIV waterborne movements. A map showing Group XIV PSAs is presented in the appendix to this report.

In addition to PSAs, external areas which are linked to the ORB through waterborne commerce have been identified. Areas (BEAs) outside the ORB which are destinations of waterborne manufactured products, nec., movements originating in the ORB are designated as Secondary Consumption Areas (SCAs). Areas (BEAs) outside the ORB which are origins of Group XIV waterborne movements and destined to the ORB are designated as Secondary Production Areas (SPAs).

A. Description of Group XIV

The individual products included in Group XIV are:

Waterborne Commerce Statistics Code (WCSC)	Product
3411	Fabricated metal products, except ordnance, machinery, and transportation equipment

3511	Machinery, except electrical
3611	Electrical machinery, equipment and supplies
3711	Motor vehicles, parts and equipment
3721	Aircraft and parts
3731	Ships and boats
3791	Miscellaneous transportation equipment
3811	Instruments, photographic and optical goods, watches and clocks
3911	Miscellaneous products of manufacturing.

Historical data indicate that only four product groups within Group XIV may be expected to generate significant future waterborne traffic flows in the ORS. These are:

- Fabricated metal products (WCSC 3411)
- Machinery (3511)
- Electrical machinery (3611)
- Ships and boats (3731).

In the 1969-76 period, these four product groups accounted for most of Group XIV waterborne movements in the ORS (Table 1).

B. Existing Waterway Traffic Flows

Total waterborne shipments of Group XIV totalled 593.4 thousand tons in 1969 (Table 1). By 1976, the total had decreased to 351.6 thousand tons, due mostly to decreases in shipments of fabricated metal products and electrical machinery. Group XIV products did not contribute substantial amounts to ORS inbound, outbound or local movements. In 1976, the portion of these ORS shipments ranged from 0.1 to 0.4 percent (Table 2).

Major shipping areas using the ORS in 1976 were BEAs 49 (Nashville) and 66 (Pittsburgh), which shipped 83.4 thousand tons and

Table 1 . Ohio River System: Waterborne Shipments of Manufactured Products by Product Inbound, Outbound, and Local Movements, 1969-76

(Thousands of tons unless otherwise specified)

Product and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Total	593.4	442.5	776.3	391.1	353.8	341.2	360.0	351.6	(7.2)
Inbound	208.2	108.0	205.6	85.9	83.7	84.6	89.8	83.0	(12.3)
Outbound	134.7	153.2	242.5	98.8	69.5	55.6	103.2	103.8	(3.7)
Local	250.5	181.3	328.2	206.4	200.6	201.0	167.1	164.8	(5.8)
Fabricated metal products	304.4	54.7	461.2	129.9	102.1	37.6	57.0	57.8	(21.1)
Inbound	120.4	14.0	129.3	33.9	20.6	11.4	8.5	15.4	(25.5)
Outbound	82.7	29.3	191.5	61.6	42.8	10.9	31.1	25.0	(15.7)
Local	101.3	11.4	140.4	34.4	38.7	15.3	17.4	17.4	(22.2)
Machinery	155.1	197.9	155.8	138.9	105.3	102.7	102.8	128.4	(2.7)
Inbound	6.5	5.9	18.3	26.8	11.5	5.4	29.2	52.2	34.7
Outbound	29.1	83.3	25.0	20.4	8.3	14.1	14.8	10.0	(14.2)
Local	119.5	108.7	112.5	91.7	85.5	83.2	58.8	66.2	(8.1)
Electrical machinery	66.2	80.6	45.6	35.2	61.8	78.6	70.1	62.1	(0.9)
Inbound	63.7	53.6	30.6	25.2	51.6	64.7	47.8	14.4	(19.1)
Outbound	2.2	26.2	12.2	7.6	10.2	12.6	21.0	46.6	54.7
Local	0.3	0.8	2.8	2.4	--	1.3	1.3	1.1	20.4
Motor vehicles	--	--	0.4	--	--	0.3	1.6	--	--
Inbound	--	--	--	--	--	0.2	1.3	--	--
Outbound	--	--	0.4	--	--	--	--	--	--
Local	--	--	--	--	--	0.1	0.3	--	--
Aircraft and parts	--	0.3	--	--	--	--	--	--	--
Inbound	--	0.3	--	--	--	--	--	--	--
Outbound	--	--	--	--	--	--	--	--	--
Local	--	--	--	--	--	--	--	--	--

(Continued)

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Table 1. (Continued).

Product and type of movement	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Ships and boats	62.6	107.5	112.5	87.0	84.7	117.8	122.5	102.3	7.3
Inbound	17.5	34.2	26.8	--	--	--	--	--	--
Outbound	20.1	13.1	13.4	9.1	8.3	17.5	36.3	22.2	1.4
Local	25.0	60.2	72.3	77.9	76.4	100.3	86.2	80.1	18.1
Transportation equipment	--	--	--	--	--	3.2	3.6	--	--
Inbound	--	--	--	--	--	2.9	3.0	--	--
Outbound	--	--	--	--	--	--	--	--	--
Local	--	--	--	--	--	0.3	0.6	--	--
Instruments, photographic, optical, watches, clocks	--	--	--	--	--	0.7	2.3	--	--
Inbound	--	--	--	--	--	--	--	--	--
Outbound	--	--	--	--	--	0.3	--	--	--
Local	--	--	--	--	--	0.4	2.3	--	--
Manufactured products, nec.	5.0	1.5	0.8	--	--	0.2	0.2	1.1	(19.5)
Inbound	--	--	0.6	--	--	--	--	1.1	a
Outbound	0.6	1.4	--	--	--	0.2	--	--	--
Local	4.4	0.1	0.2	--	--	a	0.2	--	b

Note: Individual items may not add to totals due to rounding.
a. Less than 50 tons.
b. No tonnages reported in 1969.
Source: Compiled by RRNA from Waterborne Commerce by Port Equivalents, 1969-76, supplied by U.S. Army Corps of Engineers.

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Table 2. Ohio River System: Waterborne Shipments of All Commodities and of Manufactured Products, Nec., 1976

(Thousands of tons unless otherwise specified)

	Total	Inbound	Outbound	Local
All commodities	200,770.5	29,439.5	26,854.0	144,477.0
Manufactured products, nec.	351.6	83.0	103.8	164.8
As a percentage of all commodities	0.2	0.3	0.4	0.1

Source: Compiled by RRNA from Waterborne Commerce by Port Equivalents, revised 1976, supplied by U.S. Army Corps of Engineers.

105.3 thousand tons, respectively (Table 3). BEA 49 is the location of Nashville Bridge Company, a subsidiary of American Ship Building Company, which manufactures barges and hulls. BEA 66's shipments included machinery and fabricated metal products. Two major firms in BEA 66 shipping these products were Shenango Steel Builders, Inc., manufacturers and erectors of pre-engineered steel buildings, structural steel and industrial siding, and U.S. Steel Corporation. Of the 105.3 thousand tons originating in BEA 66, 62.8 thousand tons were local to the BEA, i.e., received at port equivalents (PEs) within the Pittsburgh area. These shipments were received by steel manufacturers and other industrial plants.

Major shippers outside the ORB were BEAs 138 (New Orleans) and 140 (Beaumont). These BEAs shipped machinery and electrical machinery to the ORB. Major receivers outside the ORB were BEAs 138 (New Orleans) and 141 (Houston). BEA 138 received 75.8 thousand tons of which 20.0 thousand tons were ships and boats shipped from BEA 47 (Huntsville).

C. Summary of Study Findings

During the period 1969-76, consumption of selected manufactured products in the area served by the ORS increased from 3.7 million tons to 6.5 million tons, an average annual increase of 8.3 percent. Consumption is projected to reach a level of 14.7 million tons in 2000, an average annual increase of 3.7 percent between 1974-76 and 2000. Between 2000 and 2040, consumption in the PSAs is projected to increase at an average annual rate of 2.3 percent.

During the period 1969-76, production of selected manufactured products in the PSAs increased from 7.2 million tons to 7.4 million tons. Production is projected to increase at an average annual rate of 4.0 percent between 1974-76 and 2000 and at an average annual rate of 2.2 percent between 2000 and 2040.

The average annual growth rates of gross waterborne shipments in the ORS are projected to be 4.3 percent between 1976 and 2000, and 2.1 percent between 2000 and 2040.

Table 3. Ohio River Basin: Waterborne Commerce by BEA, 1976
Group 14: Manufactured Products, Nec.

(Thousands of tons)

Origin	Total	ORB BEAs	Destination: BEA 47	BEA 48	BEA 49	BEA 50	BEA 52	BEA 54	BEA 55	BEA 62	BEA 64	BEA 65	BEA 66	BEA 115
TOTAL	351.6	247.8	2.2	5.5	13.3	1.1	41.1	2.0	7.5	6.0	7.5	1.1	69.3	91.2
ORB BEAs	268.6	164.8	--	--	1.1	--	--	2.0	5.3	6.0	4.2	1.1	65.0	80.1
BEA 47	22.2	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 48	6.7	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 49	83.4	80.1	--	--	--	--	--	--	--	--	--	--	--	80.1
BEA 50	4.4	1.1	--	--	--	--	--	--	--	--	--	1.1	--	--
BEA 52	3.3	1.1	--	--	1.1	--	--	--	--	--	--	--	--	--
BEA 54	40.0	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 55	1.1	--	--	--	--	--	--	--	--	--	--	--	--	--
BEA 62	1.1	1.1	--	--	--	--	--	--	--	--	--	--	1.1	--
BEA 64	1.1	1.1	--	--	--	--	--	--	--	--	--	--	1.1	--
BEA 66	105.3	80.3	--	--	--	--	--	2.0	5.3	6.0	4.2	--	62.8[a]	--
Non-ORB BEAs	83.0	83.0	2.2	5.5	12.2	1.1	41.1	--	2.2	--	3.3	--	4.3	11.1
BEA 38	1.1	1.1	--	1.1	--	--	--	--	--	--	--	--	--	--
BEA 45	3.3	3.3	--	2.2	--	--	--	--	--	--	--	--	1.1[b]	--
BEA 46	1.1	1.1	--	--	--	--	--	--	--	--	--	--	1.1[b]	--
BEA 77	4.4	4.4	--	--	--	1.1	--	--	--	--	2.2	--	1.1[b]	--
BEA 114	11.0	11.0	--	--	--	--	--	--	--	--	--	--	1.0	10.0
BEA 117	1.1	1.1	1.1	--	--	--	--	--	--	--	--	--	--	--
BEA 119	2.2	2.2	--	--	--	--	--	--	--	--	1.1	--	--	1.1
BEA 138	47.7	47.7	1.1	2.2	1.1	--	41.1	--	2.2	--	--	--	--	--
BEA 140	11.1	11.1	--	--	11.1	--	--	--	--	--	--	--	--	--

(Continued)

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Table 3. (Continued)

Origin	Destination									
	Non-ORB BEAs	BEA 45	BEA 77	BEA 112	BEA 133	BEA 135	BEA 138	BEA 140	BEA 141	BEA 144
TOTAL	103.8	5.5	1.1	1.1	1.1	2.1	75.8	3.3	12.7	1.1
ORB BEAs	103.8	5.5	1.1	1.1	1.1	2.1	75.8	3.3	12.7	1.1
BEA 47	22.2	--	--	--	--	--	20.0	--	2.2	--
BEA 48	6.7	--	1.1	--	--	--	5.6	--	--	--
BEA 49	3.3	--	--	--	--	--	--	3.3	--	--
BEA 50	3.3	2.2	--	1.1	--	--	--	--	--	--
BEA 52	2.2	--	--	--	1.1	1.1	--	--	--	--
BEA 54	40.0	--	--	--	--	--	40.0	--	--	--
BEA 55	1.1	--	--	--	--	--	1.1	--	--	--
BEA 62	--	--	--	--	--	--	--	--	--	--
BEA 64	--	--	--	--	--	--	--	--	--	--
BEA 66	25.0	3.3	--	--	--	1.0	9.1	--	10.5[c]	1.1
Non-ORB BEAs										
BEA 38										
BEA 45										
BEA 46										
BEA 77										
BEA 114	**Traffic external to Ohio River System**									
BEA 117										
BEA 119										
BEA 139										
BEA 140										

a. Includes 1.0 thousand tons shipped from BEA 66 via BEA 68.
b. Shipped to BEA 66 via BEA 68.
c. Includes 2.2 thousand tons shipped from BEA 66 via BEA 68.
Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

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II. MARKET DEMAND ANALYSIS

During the period 1969-76, consumption of selected manufactured products in the PSAs increased from 3,690.1 thousand tons to 6,546.8 thousand tons, an average annual increase of 8.3 percent. Consumption is projected to reach a level of 14.7 million tons in 2000, an average annual increase of 3.7 percent between 1974-76 and 2000. After the year 2000, consumption is projected to increase at an average annual rate of 2.3 percent through the year 2040, when consumption will total 35.9 million tons.

A. Market Areas

In addition to local demand for Group XIV commodities produced in the PSAs, demand also is generated by Secondary Consumption Areas (SCAs) located outside the ORB. These SCAs are defined as BEAs which are the destinations of manufactured products, nec., movements originating from the Ohio River Basin.

A-1. Primary Study Areas

This study has identified 12 BEAs and BEA segments in the ORB which either have been or will be ultimate origins or destinations of waterborne manufactured products, nec., movements. Appendix Table A-1 presents the BEAs and BEA segments which constitute the PSAs for manufactured products, and for which manufactured products consumption has been analyzed and projected.

A-2. Secondary Consumption Areas

BEAs outside the Ohio River Basin which are destinations of waterborne shipments from the ORB were not segmented. Major SCAs are BEAs 138 (New Orleans) and 141 (Houston). In 1976, they each

received 75.8 thousand tons and 12.7 thousand tons, respectively, constituting 85.5 percent of total outbound traffic.

B. Product Uses and Consumption Characteristics

The selected manufactured products analyzed in this report are fabricated metal products, machinery, electrical machinery and ships and boats. These are the products previously identified as forming the bulk of Group XIV waterborne shipments. These products are consumed by all sectors of the economy for a variety of uses, although the manufacturing sector is by far the largest consumer of manufactured goods. Demand levels for these products will reflect levels of industrial activity.

C. Existing Aggregate Demand

Table 4 presents estimated consumption of selected manufactured goods in the PSAs for the years 1969 to 1976, a period in which total consumption increased at an average annual rate of 8.3 percent.

BEAs 62 (Cincinnati) and 66 (Pittsburgh) were the two major consumers of the selected manufactured goods. Consumption increased at the fastest rates in BEAs 48 (Chattanooga) and 65 (Clarksburg), with average annual rates of 10.0 percent and 10.2 percent, respectively.

D. Forecasting Procedures and Assumptions

Estimates of consumption of the selected manufactured products moving on the waterway were obtained from the 1972 Census of Transportation.[1] The Census of Transportation provides information regarding receipts for nine geographic divisions which are aggregations of states. To obtain estimates of receipts by state, division totals were disaggregated to state level totals by using the distribution of total employment among states in each geographic division. Consumption by county was estimated for 1972 using the distribution of total earnings among counties within each state. Then, the counties were aggregated into BEAs and BEA segments (PSAs) to obtain estimates by PSA of 1972 consumption. Percentage changes in consumption by PSA for the years 1969-76 were assumed to be equal to percentage changes in total earnings by PSA

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1. U.S. Department of Commerce, Bureau of the Census, Census of Transportation, 1972 ed. (Washington, D.C.: GPO, 1976).

Table 4. Ohio River Basin: Consumption of Selected Manufactured Products,[a] by BEAs or BEA Segments,[b] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	3,690.1	3,898.4	4,111.4	4,523.4	5,053.1	5,521.1	5,860.2	6,546.8
BEA 47: Huntsville, AL	172.7	184.5	199.3	220.5	244.8	261.3	275.3	311.5
BEA 48: Chattanooga, TN	195.0	205.6	225.3	260.1	298.1	317.5	329.9	381.0
BEA 49: Nashville, TN	392.0	412.3	444.2	503.7	584.9	639.3	663.4	760.6
BEA 50: Knoxville, TN	169.2	180.1	196.1	218.5	244.7	268.3	286.0	326.9
BEA 52: Huntington, WV	253.2	274.2	294.4	316.2	355.2	392.1	430.6	491.6
BEA 54: Louisville, KY	382.0	400.6	419.2	459.4	509.8	547.1	566.5	621.2
BEA 55: Evansville, IN	228.6	236.8	256.0	284.9	328.8	355.3	389.5	436.7
BEA 62: Cincinnati, OH	824.7	869.4	895.5	966.0	1,069.5	1,159.8	1,222.6	1,348.4
BEA 64: Columbus, OH	100.9	108.3	114.2	123.3	136.3	154.0	157.1	175.5
BEA 65: Clarksburg, WV	46.9	51.5	58.0	67.2	70.3	77.0	84.4	92.5
BEA 66: Pittsburgh, PA	875.4	922.1	951.1	1,040.8	1,140.2	1,272.9	1,372.7	1,510.6
BEA 115: Paducah, KY	48.5	53.0	58.1	62.8	71.2	76.5	82.2	90.3

Note: Receipts of selected manufactured goods (SIC 34, 35, 36, 3731 and 3732) for different regions from U.S. Department of Commerce, Bureau of the Census, Census of Transportation, and distributed among states on the basis of employment distribution. Estimates of selected manufactured products consumption by BEA and BEA segment was obtained by multiplying annual earnings of each BEA and BEA segment by the ratio of selected manufactured goods consumption to total earnings by state in 1972.

a. Includes fabricated metal, machinery products, electrical machinery products, ships and boats.

b. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of Commerce, Bureau of the Census, Census of Transportation, 1972 ed., and County Business Patterns, 1972 ed. Annual county earnings by industry provided by U.S. Department of Commerce, Bureau of Economic Analysis.

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(in terms of real dollars). Earnings by PSA were estimated from county level earnings data obtained from the Bureau of Economic Analysis in the U.S. Department of Commerce.

Future consumption by PSA was estimated on the basis of the 1972 OBERS Projections,[1] prepared by the U.S. Department of Commerce for the U.S. Water Resources Council. The OBERS projections include projections of total earnings, by BEA, through the year 2020. It was assumed, for this study, that changes in each BEA segment would occur at the same rates as changes in the BEA. The percentage change by BEA in total earnings for the period 2020-2040 was assumed to be equal to half the rate of change in total earnings projected for the period 2000-2020. Consumption of selected manufactured products by PSA was assumed to increase at the same rate as total earnings by PSA.

E. Probable Future Demand

Table 5 presents projections of the selected manufactured products in the PSAs. Between 1974-76 and 2000, total consumption is projected to increase from 6.0 million tons to 14.6 million tons, an average annual increase of 3.7 percent. During the 2000-2040 period, the average annual rate of change is projected to be 2.3 percent, increasing from 14.6 million tons to 35.9 million tons.

Major PSAs will continue to be BEAs 62 (Cincinnati) and 66 (Pittsburgh). Consumption in BEAs 47 (Huntsville) and 49 (Nashville) will increase at the highest rates.

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1. U.S. Water Resources Council, OBERS Projections, Regional Economic Activity in the United States, Series E, 1972 ed. (Washington, D.C.: GPO, 1974) Vols. I and II.

Table 5. Ohio River Basin: Consumption of Selected Manufactured Products,[a] by BEAs or BEA Segments,[b] Estimated Average 1974-76 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated average 1974-76	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1974-76—2000	2000-2040
Primary Study Areas	5,976.0	7,393.1	10,419.7	14,653.7	26,469.2	35,925.7	3.7	2.3
BEA 47: Huntsville, AL	282.7	359.1	557.7	841.5	1,740.3	2,535.8	4.5	2.8
BEA 48: Chattanooga, TN	342.8	441.7	653.8	940.2	1,731.4	2,378.3	4.1	2.3
BEA 49: Nashville, TN	687.8	873.7	1,331.1	1,970.3	3,771.7	5,283.8	4.3	2.5
BEA 50: Knoxville, TN	293.7	360.8	518.9	732.0	1,322.1	1,780.7	3.7	2.2
BEA 52: Huntington, WV	438.1	510.3	646.9	844.4	1,356.9	1,722.5	2.7	1.8
BEA 54: Louisville, KY	578.3	738.1	1,103.1	1,617.2	3,095.8	4,337.0	4.2	2.5
BEA 55: Evansville, IN	393.8	490.7	692.2	967.0	1,746.5	2,352.3	3.7	2.2
BEA 62: Cincinnati, OH	1,243.6	1,549.8	2,165.1	3,024.7	5,357.8	7,216.2	3.6	2.2
BEA 64: Columbus, OH	162.2	207.0	303.5	440.7	827.4	1,136.6	4.1	2.4
BEA 65: Clarksburg, WV	84.6	100.5	137.7	190.5	337.4	454.4	3.3	2.2
BEA 66: Pittsburgh, PA	1,385.4	1,661.4	2,168.6	2,886.2	4,822.5	6,244.0	3.0	1.9
BEA 115: Paducah, KY	83.0	100.0	141.1	199.0	359.4	484.1	3.6	2.2

Note: Estimates of 1980-2020 consumption were derived from average annual growth rates by BEA of total earnings applied to actual average 1974-76 consumption. 2040 estimates were derived using growth rates for the period 2020-2040 equal to half the projected growth rate for the period 2000-2020.

a. Includes fabricated metal products, machinery products, electrical machinery products and ships and boats.

b. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Estimated average 1974-76 consumption from Table 4. Projections estimated from growth rates by BEA from U.S. Water Resources Council, OBERS Projections, Regional Economic Activity in the U.S., Series E, 1972 ed., Vol. II.

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III. COMMODITY RESOURCE INVENTORY

During the period 1969-76, production in the PSAs of the selected manufactured products increased from 7,163.4 thousand tons to 7,449.0 thousand tons, an average increase of 0.65 percent per year. Production fluctuated in this period, with a high of over 8.0 million tons in 1974 and a low of 6.6 million tons in 1971. Production is projected to increase at an average annual rate of 4.0 percent between 1974-76 and 2000, and at an average annual rate of 2.2 percent between 2000 and 2040.

A. Production Areas

The production of Group XIV products in the PSAs is supplemented by production in Secondary Production Areas (SPAs) located outside the Ohio River Basin. These SPAs are defined as BEAs which are the origins of Group XIV waterborne movements destined to the Ohio River Basin. Major SPAs are BEAs 138 (New Orleans) and 140 (Beaumont).

B. Production Characteristics

The industries which produce the selected manufactured products are not highly concentrated industries. The fabricated metal products industry is comprised of hundreds of small companies located throughout the nation. There are a few large firms, but most fabricators have sales of $10 million or less. In 1972, there were over 38,000 firms manufacturing machinery, 10,000 firms manufacturing electrical equipment, and 2,135 firms building and repairing ships and boats.[1] Although some of these firms are quite

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1. U.S. Department of Commerce, Bureau of the Census, Census of Manufactures, 1972 ed. (Washington, D.C.: GPO, 1976) Vols. II and III.

large, none have significant shares of the total industry. However, there are firms which may dominate the market with respect to the production of a specific product. These industries manufacture thousands of different products for different uses.

The Ohio River Basin has long been an industrial center of the nation. Many of the production facilities within the ORB have been in operation many years and should continue to be used in the future. New industrial development will most likely occur in less industrial areas served by the ORS.

C. Existing Production Levels

Table 6 presents the historical production of the selected manufactured products in the PSAs for the years 1969-76. In 1976, almost 62 percent of the total PSA production occurred in three PSAs: BEAs 54 (Louisville), 62 (Cincinnati), and 66 (Pittsburgh). Pittsburgh is the major producing PSA, a result of immediate access to a prime input, steel; and of high level of local demand for manufactured goods.

Total PSA production fluctuated during the period 1969-76, ranging from a low of 6.6 million tons in 1971 to a high of 8.0 million tons in 1974.

D. Forecasting Procedures and Assumptions

Historical production estimates were based on shipment data reported in the 1972 Census of Transportation.[1] These data exclude shipments consumed with 25 miles of plants where produced, shipments moved by parcel post and products moved by own power or towed. The production estimates, therefore, underestimate the production of ships and boats, most of which are moved by their own power or towed. This, however, presented no difficulty in terms of shipment projections. The waterborne shipment of ships and boats were projected to increase at the same rate as the production of the other selected manufactured products.

Projections of production were estimated separately for fabricated metal products, machinery, electrical machinery and ships and boats. Growth rates of earnings by industry, by BEA, were taken

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1. U.S. Department of Commerce, Bureau of the Census, Census of Transportation, 1972 ed. (Washington, D.C.: GPO, 1976).

Table 6. Ohio River Basin: Production of Selected Manufactured Products,[a] by BEAs or BEA Segments,[b] Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
Primary Study Areas	7,163.4	7,150.3	6,553.6	6,965.7	7,533.8	8,023.0	7,214.7	7,449.0
BEA 47: Huntsville, AL	85.0	88.7	85.8	93.9	100.9	114.5	102.4	109.5
BEA 48: Chattanooga, TN	348.5	342.6	331.2	355.1	395.9	439.4	363.5	381.1
BEA 49: Nashville, TN	462.1	467.0	436.5	482.2	531.9	585.9	483.9	507.0
BEA 50: Knoxville, TN	97.3	103.1	96.6	104.6	118.4	137.1	113.5	119.5
BEA 52: Huntington, WV	421.0	439.4	395.0	438.4	485.2	511.3	540.7	570.0
BEA 54: Louisville, KY	1,243.7	1,272.9	1,156.1	1,302.3	1,412.9	1,505.6	1,237.1	1,319.4
BEA 55: Evansville, IN	438.3	442.3	401.0	437.8	472.0	500.2	406.5	431.0
BEA 62: Cincinnati, OH	1,417.3	1,345.5	1,259.6	1,273.3	1,363.6	1,438.5	1,275.6	1,305.1
BEA 64: Columbus, OH	359.5	363.7	309.7	346.2	377.7	388.6	393.8	411.9
BEA 65: Clarksburg, WV	178.1	187.8	182.8	195.7	217.5	230.4	250.0	266.1
BEA 66: Pittsburgh, PA	2,071.3	2,055.2	1,861.5	1,892.2	2,010.6	2,122.2	2,008.8	1,987.6
BEA 115: Paducah, KY	41.3	42.1	37.8	44.0	47.2	49.3	38.9	40.8

Note: Production excludes shipments of selected manufactured goods consumed within 25 miles of plant where produced, shipments moved by parcel post and commodities moved by own power. Production of fabricated machinery products, machinery products, and electrical machinery products by state was obtained for 1972 from Census of Transportation. Production of each of these product groups was distributed to BEAs and BEA segments on basis of employment. Annual changes in employment in each of these industries by state, applied to appropriate state portions of BEAs and BEA segments, were the basis for estimating annual levels of production.

a. Includes fabricated metal products, machinery products, electrical machinery products, and ships and boats.

b. BEA segments defined as the counties which are ultimate origins or destinations of waterborne movements

Source: Estimated from U.S. Department of Commerce, Bureau of the Census, Census of Transportation, 1972 ed., and County Business Patterns, 1969-76 eds.

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from the 1972 OBERS Projections[1] prepared by the U.S. Department of Commerce. Production by BEA segment was assumed to increase at the same rate as earnings by industry by BEA.

E. Probable Future Production Levels

Production of selected manufactured products in the PSAs was projected to increase from 7.6 million tons per year to 20.1 million tons per year between 1974-76 and 2000, an average increase of 4.0 percent per year (Table 7). By 2040, production is projected to reach an annual level of 48.0 million tons.

The major producing PSAs will continue to be BEAs 54 (Louisville), 62 (Cincinnati) and 66 (Pittsburgh). The BEAs with the highest growth rates will be BEAs 49 (Nashville) and 115 (Paducah).

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1. U.S. Water Resources Council, OBERS Projections, Regional Economic Activity in the United States, Series E, 1972 ed. (Washington, D.C.: GPO, 1974), Vols. I and II.

Table 7. Ohio River Basin: Production of Selected Manufactured Products[a] by BEAs or BEA Segments,[b] Estimated Average 1974-76 and Projected 1980-2040

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated average 1974-76	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1974-76-2000	2000-2040
Primary Study Areas	7,561.2	9,905.0	14,252.3	20,061.1	35,621.5	47,984.3	4.0	2.2
BEA 47: Huntsville, AL	108.9	147.7	221.8	324.4	612.1	847.7	4.47	2.43
BEA 48: Chattanooga, TN	394.6	552.8	882.2	1,327.2	2,570.2	3,669.3	4.97	2.58
BEA 49: Nashville, TN	525.6	731.9	1,198.4	1,822.3	3,518.2	5,026.5	5.10	2.57
BEA 50: Knoxville, TN	123.3	164.8	263.0	386.9	726.3	1,000.6	4.68	2.40
BEA 52: Huntington, WV	540.6	742.2	1,144.7	1,650.2	2,971.2	3,997.8	4.57	2.24
BEA 54: Louisville, KY	1,354.0	1,871.2	2,917.1	4,318.1	8,209.4	11,393.1	4.75	2.46
BEA 55: Evansville, IN	445.9	593.0	873.3	1,249.6	2,270.1	3,074.5	4.21	2.28
BEA 62: Cincinnati, OH	1,339.8	1,681.1	2,228.1	2,970.3	4,883.9	6,287.9	3.24	1.89
BEA 64: Columbus, OH	398.2	509.9	694.0	936.9	1,561.1	2,021.1	3.48	1.94
BEA 65: Clarksburg, WV	248.8	324.5	482.5	680.1	1,198.3	1,595.8	4.10	2.16
BEA 66: Pittsburgh, PA	2,039.5	2,522.7	3,245.2	4,241.4	6,802.4	8,652.9	2.97	1.80
BEA 115: Paducah, KY	42.0	63.2	102.0	153.7	298.3	417.1	5.33	2.53

Note: 1974-76 average production for each product category was multiplied by the appropriate industrial growth rate in earnings estimated by BEA in the OBERS projections to obtain 1980-2020 projections by BEAs and BEA segments. The annual growth rates from 2020 to 2040 were assumed to be equal to half the annual growth rates from 2000 to 2040.

a. Includes fabricated metal products, machinery products, electrical machinery products, and ships and boats.

b. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: 1974-76 average annual production from Table 6. Annual growth rates derived from U.S. Water Resources Council, OBERS Projections, Regional Economic Activity in the U.S., Series E, 1972 ed., Vol. II

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IV. TRANSPORTATION CHARACTERISTICS

Truck is the primary means of transportation used for the shipment of manufactured products. Most of the products have high value. Shippers and receivers of these products prefer rapid means of transport rather than leaving expensive machinery and products to be non-productive for long periods of time. This cost of capital consideration outweighs the relative freight cost savings of many alternative modes of transport. Moreover, many of the markets for selected manufactured products are local; therefore, truck is often the least expensive means of shipment.

A. Existing and Historical Modal Split

Table 8 presents the 1976 modal split by PSA. Gross shipment data were available only for water and rail shipments. The net truck figure understates the importance of the truck mode. Gross truck movements were probably equal to several times the gross rail movements. Gross rail movements in the PSAs were 2,864.8 thousand tons in 1976, while gross water shipments were 351.6 thousand tons.

B. Forecasting Procedures and Assumptions

Projections of modal split and waterborne shipments and receipts were based on 1976 transportation patterns. Initial projections of waterborne commerce were developed using preliminary information provided by the Corps of Engineers. These initial projections were derived according to the following procedures: (1) for BEAs 48 (Chattanooga), 66 (Pittsburgh) and 115 (Paducah), the relationships between net water and waterborne receipts, and between net water and waterborne shipments, were kept constant; (2) for the other PSAs, waterborne receipts were assumed to increase at the same rate as consumption, and waterborne shipments were assumed to increase at the same rate as production. Net water shipments were obtained by subtracting receipts from shipments.

Table 8. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation, of Selected Manufactured Products,[a] by BEAs and BEA Segments,[b] Estimated 1976

(Thousand of tons)

BEA and BEA segment	Production	Consumption	Shipments (receipts)									
			Total net	Water[c]				Rail[d]				Net truck
				Net	Inbound	Outbound	Local	Net	Inbound	Outbound	Local	
Primary Study Areas	7,449.0	6,546.8	902.2	20.8	83.0[e]	103.8[e]	164.8[e]	668.8	925.0[e]	1,593.8[e]	345.7[e]	212.6
BEA 47: Huntsville, AL	109.5	311.5	(202.0)	20.0	2.2	22.2	--	(8.8)	24.4	15.6	--	(213.2)
BEA 48: Chattanooga, TN	381.1	381.0	0.1	1.2	5.5	6.7	--	64.8	70.6	135.4	--	(65.9)
BEA 49: Nashville, TN	507.0	760.6	(253.6)	70.1	13.3	83.4	--	7.5	97.2	104.7	3.0	(331.2)
BEA 50: Knoxville, TN	119.5	326.9	(207.4)	3.3	1.1	4.4	--	17.7	16.5	34.2	--	(220.4)
BEA 52: Huntington, WV	570.0	491.6	78.4	(37.8)	41.1	3.3	--	(34.5)	102.2	67.7	37.0	150.7
BEA 54: Louisville, KY	1,319.4	621.2	698.2	38.0	2.0	40.0	--	187.0	178.8	365.8	--	473.2
BEA 55: Evansville, IN	431.0	436.7	(5.7)	(6.4)	7.5	1.1	--	7.0	31.0	38.0	1.4	(6.3)
BEA 62: Cincinnati, OH	1,305.1	1,348.4	(43.3)	(4.9)	6.0	1.1	--	(90.4)	325.2	234.8	6.7	52.0
BEA 64: Columbus, OH	411.9	175.5	236.4	(6.4)	7.5	1.1	--	1.3	11.0	12.3	1.1	241.5
BEA 65: Clarksburg, WV	266.1	92.5	173.6	(1.1)	1.1[f]	--	--	0.0	9.5	9.5	--	174.7
BEA 66: Pittsburgh, PA	1,987.6	1,510.6	477.0	36.0	6.5[f]	42.5[g]	62.8[h]	512.2	203.8	716.0	142.4	(71.2)
BEA 115: Paducah, KY	40.8	90.3	(49.5)	(91.2)	91.2	--	--	5.0	4.1	9.1	--	36.7

a. Includes fabricated metal products, machinery products, electrical machinery products, ships and boats.
b. BEA segments defined as counties which are origins or destinations of waterborne movements.
c. Includes 1.1 thousand tons of manufactured products, nec.
d. Rail movements of selected manufactured products were estimated from rail movements of all manufactured products using 1972 ratio of rail movements of selected manufactured products to total rail shipments of manufactured products to, from and within the Ohio River Basin.
e. Primary Study Areas shipments equal inbound, outbound, and local shipments for the PSAs as a unit and do not equal the sum of shipments reported for each of the BEA segments.
f. Includes 1.1 thousand tons shipped to BEA 66 via BEA 68.
g. Includes 10.5 thousand tons shipped from BEA 66 via BEA 68.
h. Includes 2.2 thousand tons shipped from BEA 66 via BEA 68.

Source: Production and consumption from Table 4 and 6. Water and rail shipments compiled by RRNA from Waterborne Commerce by Port Equivalents, revised 1976, and ICC Railroad Waybill Sample, 1976, supplied by the U.S. Army Corps of Engineers.

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These projections of shipments and receipts were distributed among BEA-to-BEA links using historical distributions of shipments among BEA receivers (adjusted for projected changes in BEA shipments and receipts) and specific knowledge acquired by commodity specialists during the course of this study.

As more complete information was made available by the Corps of Engineers, the initial projections of BEA-to-BEA waterborne traffic were adjusted.[1]

Net truck and net rail shipments were projected assuming net movements by these two modes would maintain a constant ratio to one another, except in the cases of BEAs 48 (Chattanooga), BEA 55 (Evansville), and BEA 62 (Cincinnati). Net rail shipments in BEAs 48 and 55 were projected to increase at the same rate as production, and net rail receipts in BEA 62 were projected to increase at the same rate as consumption.

C. Probable Future Modal Split

A summary of the modal split of Group XIV product shipments in the area served by the ORS for the base year 1976 and for all the projection years is presented in Table 9.

Net shipments by all modes will increase substantially through the period 1976-2000, a reflection of the higher rate of increase in projected production relative to projected consumption.

D. Probable Future Waterway Flows

Detailed BEA-to-BEA waterborne traffic projections are presented in Table 10. Growth indices derived from the traffic projections are presented in Table 11.

The average annual growth rate of gross waterborne shipments in the ORS was projected to be 4.3 percent between 1976 and 2000 and 2.1 percent between 2000 and 2040 (Table 9).

Outbound shipments will show the highest rate of increase during the projection period. As with net shipments, this is due to greater projected increases in production than projected increases in consumption.

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1. A description of the manner in which the initial projections were adjusted is contained in the Methodology Report.

Table 9. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Manufactured Products, Nec., Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

	Estimated	Projected					Average annual percentage change	
	1976	1980	1990	2000	2020	2040	1976-2000	2000-2040
Production[a]	7,449.0	9,905.0	14,252.3	20,061.1	35,621.5	47,984.3	4.2	2.2
Consumption[a]	6,546.8	7,393.1	10,419.7	14,653.7	26,469.2	35,926.7	3.4	2.3
Net shipments (receipts)	902.2	2,511.9	3,832.6	5,407.4	9,152.3	12,058.6	7.8	2.0
Net waterborne	20.8	132.5	230.8	364.4	709.6	1,017.8	12.7	2.6
Net rail[b]	668.8	1,158.0	1,517.5	1,986.1	3,150.2	4,094.7	4.6	1.8
Net truck	212.6	1,221.4	2,084.3	3,056.9	5,292.5	6,946.1	11.8	2.1
Gross waterborne shipments:								
Outbound	103.8	222.6	347.8	520.3	968.8	1,352.5	7.0	2.4
Inbound	83.0	90.1	117.0	155.9	259.2	334.7	2.7	1.9
Local	164.8	196.0	237.0	293.9	437.8	529.1	2.4	1.5
Total	351.6	508.7	701.8	970.1	1,665.8	2,216.3	4.3	2.1

Note: Projected net shipments (receipts) determined by subtracting projected consumption from projected production. Waterborne shipments and receipts were first projected on the basis of preliminary information provided by the Corps of Engineers. Projected modal split for the ORB was estimated from projections of modal split for each BEA and BEA segment. For BEAs 48, 66, and 115, projected modal split was assumed to remain constant except when data and analyses indicated otherwise. Gross waterborne shipments (inbound, outbound, and local) were projected by assuming that the relationship between gross and net waterborne shipments would remain constant. For other BEAs, waterborne receipts were projected to increase at the same rate as consumption and waterborne shipments were projected to increase at the same rate as production. As more complete information regarding 1976 waterborne traffic was made available, BEA to BEA traffic projections were revised, and projected to increase/decrease at the same rates as projected earlier. The 1976 relationship between net rail and net truck was assumed to remain constant, except when data and analyses indicated otherwise.

a. Includes fabricated metal products, machinery, electrical machinery and ships and boats.

b. Net rail shipments for BEA 48 and BEA 55 were projected to increase at the same rate as production. Net rail receipts for BEA 62 were projected to increase at the same rate as consumption.

Source: Tables 5, 7, and 8; Waterborne Commerce by Port Equivalents, 1969-76, supplied by U.S. Army Corps of Engineers.

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Table 10. Ohio River System: BEA-to-BEA Waterborne Traffic of Manufactured Projects, Nec. Actual 1976 and Projected 1980-2040, Selected Years

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS					
			1976	1980	1990	2000	2020	2040
038	048	14	11	13	20	26	51	68
045	048	14	22	25	23	31	51	81
045	068	14	11	20	17	23	36	45
046	066	14	11	20	25	31	46	56
047	138	14	200	205	217	249	304	198
047	141	14	22	45	135	261	725	1320
048	077	14	11	24	53	86	178	264
048	138	14	56	84	115	168	321	367
049	052	14	0	59	264	559	1141	1500
049	115	14	801	591	619	678	903	999
049	138	14	0	459	883	1410	2992	4598
049	140	14	33	47	78	119	230	326
050	045	14	22	31	46	68	121	163
050	065	14	11	11	15	22	40	55
050	112	14	11	15	24	35	67	92
052	049	14	11	15	25	33	62	85
052	133	14	11	22	37	57	92	117
052	135	14	11	14	22	32	57	77
054	138	14	400	553	862	1276	2425	3366
055	138	14	11	20	18	24	44	59
062	066	14	11	17	17	18	13	13
064	066	14	11	13	19	24	41	54
066	045	14	33	60	172	260	492	697
066	054	14	20	23	35	51	95	131
066	055	14	53	64	93	127	221	251
066	062	14	60	73	97	137	223	293
066	064	14	42	51	76	112	208	285
066	066	14	618	1031	1094	1158	1399	1585
066	135	14	10	18	23	29	41	50
066	138	14	91	273	300	441	499	521
066	141	14	83	279	374	516	789	877
066	144	14	11	20	25	31	46	57
068	066	14	10	12	16	20	32	40
068	141	14	22	57	94	141	265	374
077	050	14	11	12	16	22	36	48
077	064	14	22	40	50	63	91	111
077	068	14	11	12	16	22	36	48
114	066	14	10	20	50	60	120	190
114	115	14	100	75	82	113	166	168
117	047	14	11	13	19	30	62	90
119	064	14	11	11	22	33	68	91
119	115	14	11	9	11	12	13	14
138	047	14	11	11	13	17	29	29
138	048	14	22	22	29	34	61	61
138	049	14	11	13	17	23	41	41
138	052	14	411	368	292	187	83	65
138	055	14	22	22	30	44	86	145
138	066	14	0	72	276	570	1149	1516
140	049	14	111	123	162	218	367	480
		TOTAL	3516	5087	7018	9701	15658	22163

Source: Robert R. Nathan Associates, Inc.

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Table 11. Ohio River System: Growth Rates of Manufactured Products, Nec., Waterborne Commerce, BEA to BEA, Projected 1976-2040, Selected Years

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
038048	14	11	1000	1200	1800	2400	4600	6200
045048	14	22	1000	1133	1067	1400	2333	3667
045068	14	11	1000	1778	1528	2056	3306	4083
046066	14	11	1000	1786	2286	2857	4143	5071
047138	14	200	1000	1027	1087	1246	1519	989
047141	14	22	1000	2045	6136	11864	32955	60000
048077	14	11	1000	2222	4778	7778	16222	24000
048138	14	56	1000	1500	2059	3000	5735	6559
049052	14	59	0	1000	4475	9475	19339	25424
049115	14	801	1000	738	773	846	1127	1247
049138	14	459	0	1000	1924	3072	6519	10017
049140	14	33	1000	1429	2357	3607	6964	9929
050045	14	22	1000	1400	2100	3100	5500	7400
050065	14	11	1000	1000	1400	2000	3600	5000
050112	14	11	1000	1357	2214	3214	6071	8357
052049	14	11	1000	1375	2250	3000	5625	7750
052133	14	11	1000	2000	3400	5200	8400	10600
052135	14	11	1000	1313	2000	2875	5188	7000
054138	14	400	1000	1382	2154	3189	6063	8415
055138	14	11	1000	1833	1667	2167	4000	5333
062066	14	11	1000	1500	1500	1667	1167	1167
064066	14	11	1000	1200	1700	2200	3700	4900
066045	14	33	1000	1811	5226	7887	14906	21132
066054	14	20	1000	1151	1726	2534	4726	6534
066055	14	53	1000	1216	1757	2405	4162	4730
066062	14	60	1000	1222	1611	2278	3722	4889
066064	14	42	1000	1210	1802	2667	4963	6790
066066	14	618	1000	1669	1770	1874	2263	2565
066135	14	10	1000	1750	2250	2875	4125	5000
066138	14	91	1000	3000	3298	4851	5489	5723
066141	14	83	1000	3360	4500	6220	9500	10570
066144	14	11	1000	1857	2286	2857	4143	5143
068066	14	10	1000	1247	1567	2023	3170	3998
068141	14	22	1000	2597	4281	6429	12043	17000
077050	14	11	1000	1111	1462	1966	3307	4320

(Continued)

Table 11, (Continued)

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
077064	14	22	1000	1818	2273	2864	4136	5045
077068	14	11	1000	1111	1462	1966	3307	4320
114066	14	10	1000	2000	5000	6000	12000	19000
114115	14	100	1000	750	821	1131	1655	1679
117047	14	11	1000	1154	1769	2692	5615	8154
119064	14	11	1000	1000	2000	3000	6143	8286
119115	14	11	1000	833	1000	1083	1167	1250
138047	14	11	1000	1000	1167	1500	2667	2667
138048	14	22	1000	1000	1300	1550	2750	2750
138049	14	11	1000	1167	1542	2125	3708	3708
138052	14	411	1000	895	711	456	201	157
138055	14	22	1000	1000	1385	2000	3923	6577
138066	14	72	0	1000	3833	7917	15958	21056
140049	14	111	1000	1111	1462	1966	3307	4320

a. The first three digits indicate the BEA of origin; the last three digits indicate the BEA of destination.

b. Hundreds of tons.

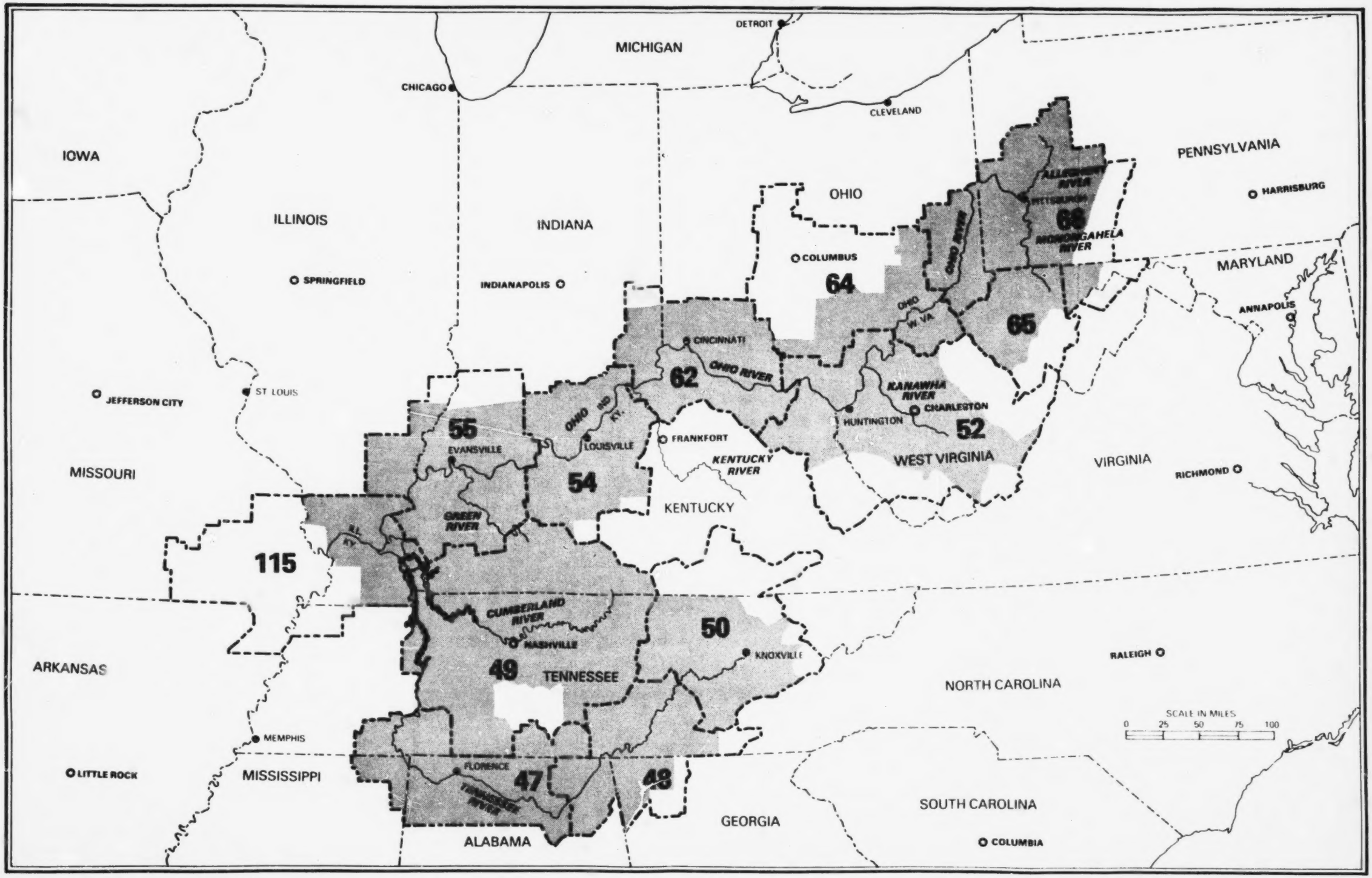
c. Growth rates are reported such that 1000 equals the index value reported in the third column.

Source: Robert R. Nathan Associates, Inc.

V. APPENDIX

BEST DOCUMENT AVAILABLE

MAP A-1. OHIO RIVER BASIN: PRIMARY STUDY AREAS FOR MANUFACTURED PRODUCTS, NEC.
(BEAs AND BEA SEGMENTS)



SOURCE: Robert R. Nathan Associates, Inc.

Primary Study Areas

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Table A-1. Ohio River Basin: Primary Study Areas for Manufactured Products, Nec. (BEAs and BEA segments)

BEA 47 (segment): Huntsville, AL
- Colbert, AL
- Franklin, AL
- Lauderdale, AL
- Lawrence, AL
- Limestone, AL
- Madison, AL
- Marshall, AL
- Morgan, AL
- Alcorn, MS
- Tishomingo, MS
- Franklin, TN
- Hardin, TN
- Lincoln, TN
- McNairy, TN
- Wayne, TN

BEA 48 (segment): Chattanooga, TN
- DeKalb, AL
- Jackson, AL
- Catoosa, GA
- Chattooga, GA
- Dade, GA
- Walker, GA
- Whitfield, GA
- Bledsoe, TN
- Bradley, TN
- Grundy, TN
- Hamilton, TN
- Marion, TN
- McMinn, TN
- Meigs, TN
- Polk, TN
- Rhea, TN
- Sequatchie, TN

BEA 49 (segment): Nashville, TN
- Allen, KY
- Barren, KY
- Butler, KY
- Christian, KY
- Clinton, KY
- Cumberland, KY
- Edmonson, KY
- Logan, KY
- Metcalfe, KY
- Monroe, KY
- Simpson, KY
- Todd, KY
- Trigg, KY
- Warren, KY
- Benton, TN
- Cannon, TN
- Cheatham, TN
- Clay, TN
- Coffee, TN
- Davidson, TN
- Dekalb, TN
- Dickson, TN
- Giles, TN
- Hickman, TN
- Houston, TN
- Humphreys, TN
- Jackson, TN
- Lawrence, TN
- Lewis, TN
- Macon, TN
- Maury, TN
- Montgomery, TN
- Overton, TN
- Perry, TN
- Pickett, TN
- Putnam, TN
- Robertson, TN
- Rutherford, TN
- Smith, TN
- Stewart, TN
- Trousdale, TN
- Van Buren, TN
- Warren, TN
- White, TN
- Williamson, TN
- Wilson, TN

BEA 50 (segment): Knoxville, TN
- Anderson, TN
- Blount, TN
- Campbell, TN
- Cumberland, TN
- Fentress, TN
- Grainger, TN
- Jefferson, TN
- Knox, TN
- Loudon, TN
- Monroe, TN
- Morgan, TN
- Roane, TN
- Scott, TN
- Sevier, TN
- Union, TN

BEA 52 (segment): Huntington, WV
- Boyd, KY
- Carter, KY
- Elliot, KY
- Greenup, KY
- Lawrence, KY
- Rowan, KY
- Gallia, OH
- Lawrence, OH
- Meigs, OH
- Scioto, OH
- Boone, WV
- Cabell, WV
- Clay, WV
- Fayette, WV
- Greenbrier, WV
- Jackson, WV
- Kanawha, WV
- Lincoln, WV
- Mason, WV
- Nicholas, WV
- Putnam, WV
- Raleigh, WV
- Roane, WV
- Sumners, WV
- Wayne, WV

BEA 54 (segment): Louisville, KY
- Clark, IN
- Crawford, IN
- Floyd, IN
- Harrison, IN
- Jefferson, IN
- Orange, IN
- Scott, IN
- Washington, IN
- Breckenridge, KY
- Bullitt, KY
- Grayson, KY
- Hardin, KY
- Henry, KY
- Jefferson, KY
- Meade, KY
- Nelson, KY
- Oldham, KY
- Shelby, KY
- Trimble, KY
- Washington, KY

(Continued)

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Table A-1 (Continued)

BEA 55 (segment): Evansville, IN
- Caldwell, KY
- Crittenden, KY
- Daviess, KY
- Hancock, KY
- Henderson, KY
- Hopkins, KY
- McLean, KY
- Muhlenberg, KY
- Ohio, KY
- Union, KY
- Webster, KY
- Edwards, IL
- Gallatin, IL
- Hamilton, IL
- Saline, IL
- Wabash, IL
- White, IL
- Dubois, IN
- Gibson, IN
- Perry, IN
- Pike, IN
- Posey, IN
- Spencer, IN
- Vanderburgh, IN

BEA 62 (segment): Cincinnati, OH
- Dearborn, IN
- Franklin, IN
- Ohio, IN
- Ripley, IN
- Switzerland, IN
- Boone, KY
- Bracken, KY
- Campbell, KY
- Carroll, KY
- Fleming, KY
- Gallatin, KY
- Grant, KY
- Kenton, KY
- Lewis, KY
- Mason, KY
- Owen, KY
- Pendleton, KY
- Robertson, KY
- Adams, OH
- Butler, OH
- Brown, OH
- Clermont, OH
- Clinton, OH
- Hamilton, OH
- Highland, OH
- Warren, OH

BEA 64 (segment): Columbus, OH
- Athens, OH
- Guernsey, OH
- Jackson, OH
- Morgan, OH
- Noble, OH
- Pike, OH
- Vinton, OH
- Washington, OH
- Pleasants, WV
- Ritchie, WV
- Wirt, WV
- Wood, WV

BEA 65 (segment): Clarksburg, WV
- Barbour, WV
- Doddridge, WV
- Harrison, WV
- Lewis, WV
- Marion, WV
- Monongalia, WV
- Preston, WV
- Taylor, WV
- Upshur, WV

BEA 66 (segment): Pittsburgh, PA
- Garrett, MD
- Belmont, OH
- Harrison, OH
- Jefferson, OH
- Monroe, OH
- Allegheny, PA
- Armstrong, PA
- Beaver, PA
- Butler, PA
- Clarion, PA
- Fayette, PA
- Greene, PA
- Indiana, PA
- Washington, PA
- Westmoreland, PA
- Brooke, WV
- Hancock, WV
- Marshall, WV
- Ohio, WV
- Tyler, WV
- Wetzel, WV

BEA 115 (segment): Paducah, KY
- Hardin, IL
- Johnson, IL
- Massac, IL
- Pope, IL
- Pulaski, IL
- Union, IL
- Ballard, KY
- Calloway, KY
- Graves, KY
- Livingston, KY
- Lyon, KY
- Marshall, KY
- McCracken, KY

Source: Robert R. Nathan Associates, Inc.

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